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**EP 0 433 951 B1**

## Description

This invention pertains to absorbent articles.

Currently, disposable absorbent articles find wide spread use in infant, child, and adult incontinence care, and have generally replaced reusable cloth absorbent articles. A typical disposable absorbent article is a three-layered composite structure comprising a top-sheet material, a backsheet material, and an absorbent material disposed therebetween.

Various disposable articles are already described in the prior art.

From US-A-4 662 877, for example, a disposable diaper is known having a backing sheet, an absorbent batt and a facing sheet, the absorbent batt being sandwiched between both sheets. The facing sheet has an oval shaped aperture. Said aperture directs waste discharges to the absorbent batt structure. EP-A-0 359 410 and EP-A-0 357 298 describe a disposable absorbent article having a liquid-permeable liner, a liquid impervious backsheet and an absorbent core disposed therebetween. The liner and the backsheet differ in their longitudinal dimensions so that a void space is provided between said liner and said backsheet. Said void space is capable of accommodating fecal material which is introduced through an opening in the liner.

One problem with current absorbent articles is the amount of skin area within the article that is exposed to body waste material. For example, current baby diapers are generously cut wider in the crotch area to assist in urine and BM management. This results in excess material bunching together between the legs, which can be extremely uncomfortable to the wearer. This bunching of material is further exacerbated by the elastics of the diaper edges. Consequently, the topsheet is prevented from being in close contact with the perineum area, thereby resulting in loss of management and containment of the flow of waste material between the body orifices and topsheet surface which in turn results in the spreading of waste material along the topsheet surface and against the wearer's skin.

Another problem with current absorbent articles is that leg movements over a period of time against the excess material between the legs can cause the absorbent to break apart, thereby decreasing its absorbent effectiveness.

Yet another problem with excess material between the legs is that the churning movement of the legs on the bunched-up material in the crotch causes the article to be pulled down from the crotch area, thereby further increasing the bunching problem and exposing additional skin area to fecal matter.

Still another problem is that excess material between the legs allows shifting or moving of the article in the crotch area, thereby further increasing problems with skin exposure to waste.

These problems generally result in skin dermatitis, skin hydration, and/or messy clean-ups.

It is an object of the present invention to avoid or at

least reduce the above mentioned problems alone or in combination. This object is solved by the disposable absorbent article of independent claim 1. Further advantageous features of the article are evident from the dependent claims, the description and the drawings. The claims are intended to be understood as a first non-limiting approach of defining the invention in general terms.

The invention provides an improved disposable absorbent article that easily and closely conforms to the body, specifically in the perineum area, of the wearer to provide improved performance in managing and containing body wastes.

In one embodiment of the invention, there is provided a disposable absorbent article comprising a liquid permeable topsheet having a topsheet peripheral measurement, and a liquid impermeable backsheet having a backsheet peripheral measurement that is greater than the topsheet peripheral measurement. The topsheet periphery and the backsheet periphery are joined together to form a waste containment pocket therebetween. The liquid permeable topsheet has an opening therein and is adapted to substantially fully contact the body of the wearer.

In another embodiment of the invention, there is provided a disposable absorbent article comprising a liquid permeable topsheet, a liquid impermeable backsheet, and an absorbent between the topsheet and backsheet, a pair of containment flaps positioned near the lateral sides of the topsheet, and a pair of side flaps positioned near the lateral sides of the topsheet.

In yet another embodiment of the present invention, there is provided a disposable absorbent article comprising a topsheet having a topsheet peripheral measurement, a backsheet having a backsheet peripheral measurement, and an absorbent structure between the topsheet and the backsheet. The backsheet is expandable so that upon receiving body wastes, the backsheet expands for the containment thereof.

The above-mentioned and other features and objects of this invention, and the manner of attaining them, will become more apparent and the invention itself will be better understood by reference to the following description of the embodiment of the invention taken in conjunction with the accompanying drawings, wherein:

Figure 1 is a top plan view of a prior art diaper;  
Figure 2 is a top plan view of one embodiment of the present invention;  
Figure 3A is a side view of the prior art diaper in Figure 1 as it would appear being worn;  
Figure 3B is a front view of the prior art diaper in Figure 1 as it would appear being worn;  
Figure 4A is a side view of a second embodiment of the present invention in Figure 8 as it would appear being worn;

Figure 4B is a front view of the embodiment of the present invention in Figure 8 as it would appear being worn;

Figure 5 is a perspective view of the embodiment of the present invention in Figure 8 in its relaxed state; Figure 6 is an exploded and partially broken-away view of the embodiment of the present invention in Figure 8;

Figure 7 is a cross-sectional view of Figure 5 taken along line 7-7 and viewed in the direction of the arrows; and

Figure 8 is a top plan view of a second embodiment of the present invention.

The absorbent article of the present invention can be utilized as: a baby diaper, adult incontinence garment, feminine care product, and the like. For purposes of the present discussion, the absorbent article will be described in terms of a baby diaper designed to fit a baby weighing between about 12 to about 24 pounds, but it is understood that the features and principles of the present invention apply to other baby sizes. As illustrated in Figures 1 and 2, disposable diaper 10 of the present invention is much smaller in size than a conventional diaper 12 of the prior art. Specifically, the overall length,  $L_0$ , of diaper 10 of the present invention is about 14 inches\* to about 15 inches; while the overall length,  $L_0$ , of conventional diaper 12 is about 17 inches to about 18 inches. The overall width,  $W_0$ , of diaper 10 is about 5 inches to about 8 inches; while the overall width,  $W_0$ , of conventional diaper 12 is about 12 inches to about 13 inches. The overall width,  $W_{AO}$ , of absorbent structure 14 of diaper 10 is about 4 inches to about 7 inches; compared to the overall width,  $W_{AO}$ , of about 10 inches to about 11 inches of conventional diaper 12. The width of the absorbent at the crotch,  $W_{AC}$ , of diaper 10 is from about 2 inches to about 3 inches; while the absorbent width at the crotch,  $W_{AC}$ , of conventional diaper 12 is about 5 inches to about 6 inches.

Having compared the two diapers in size, a comparison of how they generally fit a baby is illustrated in Figures 3A-4B. In Figures 3A and 3B, conventional diaper 12 is being worn by a baby having a weight between about 12 to about 24 pounds. As illustrated, topsheet 16, absorbent 18, and backsheet 20 of conventional diaper 12 are bunched up and spaced away from crotch 24 forming a space 22 between crotch 24 and diaper 12. It is this forming of space 22 that causes loss of management and containment of waste material. The waste material spreads along topsheet 16 and contacts a large area of the baby's skin during movement of the baby. The bunching of topsheet 16, absorbent 18, and backsheet 20 at crotch 24 can cause breaking up of the absorbent material from leg movements, drooping of the diaper in the crotch, and shifting of the diaper on the baby.

Referring to Figures 4A-B, topsheet 26, absorbent

structure 14, and backsheet 30 of diaper 10 of the present invention are positioned in crotch 24 such that topsheet 26 substantially fully contacts the baby, particularly at crotch 24, thereby virtually eliminating or minimizing space 22. Topsheet contact with the body along a line centered or measured through crotch 24 from below the naval to the small of the back is important to positioning an opening or BM containment device in or associated with topsheet 26 relative to the anus to allow containment of feces under topsheet 26 or in the device. It is also important in urine control or management for immediate penetration through topsheet 26, thereby preventing urine from flowing over the topsheet surface. Two methods to obtain the preferred body contact with topsheet 26 are, first, cut and/or elastically narrow topsheet 26 to fit the crotch dimensions; and second, form the absorbent crotch width to have a width from about 2 inches to about 3 inches to allow the diaper to fit up between the baby's legs.

Referring to Figures 5 and 6, diaper 10 generally comprises liquid-permeable topsheet 26 having an opening 38 therein, liquid-impermeable backsheet 30, and absorbent structure 14 positioned therebetween.

Topsheet 26 has periphery 40 defined by front longitudinal end 44, back longitudinal end 46, and lateral sides 48. Similarly, backsheet 30 has periphery 42 defined by front longitudinal end 50, back longitudinal end 52, and lateral sides 54. Periphery 42 has a peripheral length or measurement greater than that of periphery 40. Periphery 42 can be made to have a peripheral measurement greater than periphery 40 by making topsheet 26 more narrow than backsheet 30, or more shorter than backsheet 30, or both. When topsheet 26 is joined to backsheet 30 along their respective peripheries 40, 42, waste containment pocket 56 is formed therebetween (Fig. 7). Topsheet 26 and backsheet 30 can be joined or attached in any suitable manner, such as by a line or lines of adhesive bonding, thermal bonding, or ultrasonic bonding, and can be joined at their peripheral edges or slightly inboard thereof, for example, at a distance from about one-eighth inch to about three-eighths inch or more from the peripheral edges.

Absorbent structure 14 is positioned between topsheet 26 and backsheet 30, and is joined or attached to backsheet 30 by any suitable means, such as by lines or a surface spray of adhesive. Waste containment pocket 56 is then defined between absorbent structure 14 and topsheet 26. Waste containment pocket 56 is designed to receive and contain a volume of fecal matter of at least about 150 cubic centimeters.

A dual pair of flaps are also disposed on diaper 10, and are identified as containment flaps 58 and side flaps 60. Within the context of the present disclosure, the terms "disposed", "disposed on", "disposed with", and any variations thereof, are intended to mean as a minimum that one element can be formed integrally from another element, or one element can be separate structure joined to or placed with or near another element. Side flaps 60 can be formed from extensions of

\* 1 inch = 2.54 cm

lateral sides 54 of backsheet 30 and/or lateral sides 48 of topsheet 26, or can be separate structural elements attached to backsheet 30 and/or topsheet 26. Preferably, side flaps 60 are made of liquid-impermeable material that is vapor-permeable for increased air circulation in the crotch region, but may be made, if desired, from a liquid and vapor impermeable material or a liquid and vapor permeable material. Side flaps 60 can also have selected portions that are liquid permeable with the remaining portions being liquid impermeable.

Containment flaps 58 are located inboard of side flaps 60, i.e., closer to longitudinal centerline 62 (Figure 6) than flaps 60. Centerline 62 is illustrated through absorbent structure 14, but is also intended to be the centerline for topsheet 26, backsheet 30, and diaper 10. Containment flaps 58 can be integral extensions of liquid-permeable topsheet 26, or can be separate liquid-permeable elements attached or joined to topsheet 26 inboard of side flaps 60. Flaps 58, 60 border the lateral sides of opening 38, with containment flaps 58 being closer to opening 38 than side flaps 60. Containment flaps 58 can also have selected portions that are liquid permeable with the remaining portions being liquid impermeable. Flaps 58 can also be liquid impermeable.

In one embodiment, containment flaps 58 are separate elements attached or adhered to upper surface 64 of topsheet 26, and side flaps 60 are separate elements attached or adhered between topsheet 26 and backsheet 30. Containment flaps 58 include at least one elastic member 66 in each distal edge portion 68, and preferably at least two or more elastic members 66 in each distal edge portion 68. Elastic members 66 are positioned and secured within respective distal edge portions 68 in a stretched or elastically contractible manner, such that upon relaxing elastic member 66, containment flaps 58 gather or shirr as illustrated in Figures 5, 7.

In a similar manner, side flaps 60 have elastic members 70 attached in a stretched or elastically contractible condition within respective distal edge portions 72 of side flaps 60. As illustrated in Figure 6, and with reference to a single side flap 60 since both side flaps are identical, each side flap 60 comprises narrow end portions 76 with intermediate flap portion 78 extending therebetween in a preferably curvilinear fashion to accommodate and correspond to leg cut-outs 74.

One of the important aspects of the present invention is the various methods of disposing side flaps 60 with backsheet 30. In one method of positioning side flap 60 for attachment to backsheet 30, flap 60 is first pleated or elastically gathered, and thereafter attached or joined to backsheet 30 in the pleated or gathered state in a manner that does not pleat or gather backsheet 30. In this fashion, the overall, flattened-out length of intermediate flap portion 78 is longer than the flattened-out distance between points A and B on backsheet 30; points A and B being orthogonal projections of the remote ends of intermediate flap portion 78 on backsheet 30. Thus, upon pressing or flattening backsheet

30 against a flat surface, each intermediate flap portion 78 will have a shirred or ruffled appearance that is complemented by elastic members 70.

Another method of disposing flaps 60 with backsheet 30 is to maintain pleated or elasticized flaps 60 in a stretched-out state and then attach or join them to backsheet 30 to pleat or gather backsheet 30 upon relaxation thereof.

If desired, side flaps 60 can be designed without narrow end portions 76, and elastic members 70 can be attached the full length of diaper 10. Thereafter, selected portions of elastic members 70 can be de-elasticized by application of heat or other treatment dependent upon the material of which elastic members 70 are made.

Referring to Figures 5-8, disposable diaper 10 can also include waist elastics in the longitudinal end portions of front panel 32 and back panel 34. In one embodiment illustrated in Figure 8, only back waist elastic 80 is joined to back panel 34, and can either be joined between backsheet 30 and topsheet 26 or joined only to backsheet 30 to allow greater elastic retraction. Waist elastic 80 is adhered or joined to back panel 34 in a stretched or elastically contractible condition, so that upon relaxation that portion of back panel 34 is gathered.

A pair of stretchable ears 82 are attached to opposite longitudinal sides of back panel 34, and are preferably in-line with back waist elastic 80. Since both of the stretchable ears 82 are identical, the following description will be made in terms of a single stretchable ear. Stretchable ear 82 comprises stretchable member 84 and stretchable band 86. Stretchable band 86 is connected to member 84 to aid in preventing stress failure to ear 82 and to apply additional elastic reinforcement to the center of ear 82. Both stretchable member 84 and stretchable band 86 are joined between backsheet 30 and topsheet 26, with band 86 preferably disposed on backsheet 30. Stretchable members 84 and/or stretchable bands 86 can be a stretch-bonded laminate.

Preferably, ears 82 are designed and manufactured as a single strip of elastic or stretchable material having the same stretch characteristics as the combination of stretchable member 86 and stretchable band 84.

To fit and maintain disposable diaper 10 on the wearer, a hook-and-loop fastening system is provided with tabs 88 of hook material joined to the side of stretchable member 84 opposite band 86, and panel 90 of loop material joined to backsheet 30. Although hook-and-loop fasteners are preferred, other fastening arrangements can be used, such as tapes, snap fasteners, and the like.

In one embodiment, backsheet 30 is made of a liquid-impermeable material, and preferably a polyethylene film having a thickness of about 1.0 mil\*, although thicknesses above 0.50 are functional. Backsheet 30 is

\* 1 mil = .001 Inch

1 inch = 2.54 cm

generally flat, i.e., not pleated or microcreped, and has a peripheral measurement greater than the peripheral measurement of topsheet 26. In joining backsheet 30 and topsheet 26 to form waste containment pocket 56, periphery 42 of backsheet 30 needs to be drawn inwardly to be joined to periphery 40 of topsheet 26. One method of forming backsheet 30 in this manner is by vacuum forming backsheet 30 into a mold of predetermined shape and dimensions that result in waste containment pocket 56 having a preferred shape.

In another embodiment, additional useable volume in waste containment pocket 56 is included by providing (1) a means for the feces to pass through or around the absorbent core, for example, a trapezoidal-shaped hole in the absorbent having a rear width of about 1.5 inches, a front width of about 1 inch, and sloping side lengths of about 4 inches; and (2) an outer barrier sheet, such as backsheet 30, having dimensions longer than the topsheet and absorbent core and having a space formed between backsheet 30 and the absorbent core so as to contain the fecal material between the absorbent and the backsheet.

Other means of providing additional useable volume in pocket 56 by using backsheet 30 include (a) using an embossed film which can expand easily, (b) making the backsheet from a low modulus, easily elongatable film, such as Kraton or ethyl vinyl acetate (EVA), (c) creping an ordinary film in the same method that tissue is creped to form creped wadding, (d) forming pleats in the machine direction or cross direction in the backsheet or only portions of the backsheet which can easily expand, and (e) thermal forming a bulge in the crotch area of the backsheet. Alternatively, topsheet 26 can be made of a stretchable material and cut shorter and/or narrower than backsheet 30, and then peripherally joined to backsheet 30 to provide additional useable volume.

The total volume to handle fecal matter should be at least about 150 cubic centimeters. The amount of expandability required in backsheet 30 depends on the desired degree of reduction in fecal smearing, the volume of fecal material the design is intended to handle, and the volume of the hole provided in absorbent 14 when the wearer is in the sitting position. For example, since normally 60 cubic centimeters or less of fecal material would be expelled in one defecation and if the volume of the hole in the absorbent would be about 20 cubic centimeters, then the expandability of the backsheet should handle about 40 cubic centimeters.

In order to provide this volume, experience has shown that a desirable range of expandability of backsheet 30 is from about 20% to about 100%. The exact amount is dependent on a wide range of variables including the baby's position during defecation, tightness of the baby's clothing, viscosity of the fecal material, pressure exerted by the topsheet against the body, resistance of the material to the expansion force of the bowel movement, rate of expulsion of the fecal material from the body and rigidity of the absorbent material.

Materials that readily expand about 20% or more under a force of about 25 grams per inch of width or less function adequately and can expand sufficiently to accommodate normal volume bowel movements.

Another method for fecal management would be to have a normal, non-expandable backsheet in combination with an absorbent with a hole in the absorbent; the hole having about 20 cubic centimeters to about 60 cubic centimeters volume. Also required would be a topsheet with a hole or holes sufficient to allow fecal material to pass through, and which substantially fully contacts the body along a line through the crotch from the front end of the diaper to the back. The hole can be covered or masked with an opaque material disposed between the topsheet and absorbent. Within the context of the present disclosure, the term "substantially fully contacts," and any variations thereof, is intended to mean as a minimum that topsheet 26 is sufficiently close to the body to prevent misalignment between the hole in topsheet 26 and the anus. A major portion of the upper surface, i.e., body-facing, surface area of topsheet 26 will be in contact with the skin of the wearer, except those areas of topsheet 26 that overlie the natural crevices or folds of a baby's body, such as the crevice between the baby's buttocks and the folds of skin at the juncture between the inner thighs and crotch. Naturally, if topsheet 26 has a plurality of small holes or a single larger opening therein, topsheet 26 will not contact the skin at those holes or openings. "Substantially fully contacts" can also be defined as that percent of topsheet 26 in contact with skin, for example, about 70% to about slightly less than 100% of topsheet 26 being in contact with the baby's skin.

Backsheet 30 may also be made of other materials that are suitably liquid-impermeable or treated to be so. Examples are meltblown or film material made of polypropylene or polyolefin copolymers such as ethylene vinyl acetate, ethylene methyl acrylate, ethylene ethyl acrylate, polyvinyl chloride, and the like. Other materials include a single spunbonded layer of the above types of materials, two layers of spunbonded and meltblown materials, or three layers of material of spunbonded-meltblown-spunbonded material, each of which is suitably treated or coated to be liquid-impermeable. These same materials may also be provided in laminate form. The spunbond materials provide an added feature of a cloth-like texture to backsheet 30.

Referring to Figure 6, backsheet 30 may be made of a material that is not only liquid-impermeable, but also vapor-permeable. Alternatively, backsheet 30 can have a breathable panel 92 positioned adjacent or near longitudinal end 50. As illustrated in Figure 6, breathable panel 92 and loop panel 90 may be coextensive, such that loop panel 90 forms an outer layer for breathable panel 92. However, it may be preferred that panel 92 and panel 90 be separate, i.e., not coextensive. The plurality of loops on loop panel 90 can function as heat-transfer elements that assist in reducing condensation on the diaper exterior.

Other designs include positioning panel 92 in back-sheet 30 adjacent or near back longitudinal end 52, or adjacent or near both back longitudinal end 52 and front longitudinal end 50. Breathable panel 92 has a water vapor transmission rate (WVTR) value of at least about 2000 grams/square meter/24 hours. Preferably, panel 92 has a WVTR of at least about 4000 grams/square meter/24 hours, and more preferably has a WVTR of at least about 5000 grams/square meter/24 hours. Breathable panel 92 has a preferred effective breathable area of about 30 cm<sup>2</sup>, and a preferred range of effective breathable area between about 20 to about 600 cm<sup>2</sup>. The term "effective breathable area" refers to that area of breathable panel 92 that does not have any elements, materials or other structure, whether in particulate or fibrous or other form, obstructing or minimizing it that effectively negate its breathable characteristics.

Breathable panel 92 can comprise a microporous polymer film, such as Grade TMP-1 film manufactured by Mitsui Toatsu Chemical, Inc., Tokyo, Japan; a nonwoven fibrous material, such as a spunbonded or melt-blown web composed of synthetic polymer fibers; or a calendared, composite, fibrous web which includes a barrier layer comprising fine fibers and a reinforcing layer comprising coarse fibers. The barrier layer and reinforcing layer are securely bonded together by fusing or adhering the reinforcing fibers into the barrier fibers, and the reinforcing layer is configured to conform to the outwardly facing surface of the composite web. If desired, loop panel 90 can serve as the reinforcing layer of breathable panel 92. For purposes herein, a fiber is "fine" if it has a diameter equal to or less than about 3 μm, and a fiber is "coarse" if it has a diameter equal to or greater than about 15 μm.

Breathable panel 92 has a transverse dimension, relative to longitudinal centerline 62, within the range of about 5 to about 25 centimeters, and a longitudinal dimension within the range of about 3 to about 15 centimeters. Panel 92 extends over about 10% to about 50% of the transverse dimension of absorbent structure 14.

Topsheet 26 can be a liquid-permeable, hydrophilic or hydrophobic material, such as a spunbonded web composed of synthetic polymer filaments; a spunlace web; a spunbond-meltblown web; a meltblown web; or a bonded-carded-web composed of synthetic polymer fibers. Suitable synthetic polymers include polyethylene, polypropylene, polyester, and nylon. In one embodiment, the polymer filaments have a denier\* within the range of about 1.5 to about 7 d., and preferably within the range of about 1.2 to about 6.0 d. The filaments are arranged to form a layer having a basis weight within the range of about 10 to about 35 gm/m<sup>2</sup>(gsm), and preferably a basis weight of about 20 gsm. Topsheet 26 has a bulk thickness within the range of about 0.0140 to about 0.0432 centimeters, and preferably within the range of about 0.0180 to about 0.305 centimeters. The bulk

thickness is measured under a restraining pressure of about 0.014 psi.\*

Topsheet 26 also can be a Kraton meltblown/polypropylene spunbond stretch-bonded laminate which has been made wettable by addition of surfactants; a polyurethane spunbond material such as that manufactured by Kanebo Synthetic Fibers Company, Osaka, Japan, and made wettable by addition of surfactants; an elastomeric film made from elastomers such as rubber, latex rubber, polyurethane, Kraton, and the like, which has been perforated to allow fluid passage; a polyurethane foam which has been perforated to allow fluid passage; and a nonwoven which has been gathered through the use of elastic or other means, e.g., heat-shrinkable fibers, to produce an elastically stretchable material.

Containment flaps 58 and side flaps 60 can be made of the same material as topsheet 26, and can be integrally formed therefrom or can comprise separate structure joined to topsheet 26 in any suitable manner.

Each containment flap 58 preferably comprises a single layer having a basis weight of about 0.4 ounces per square yard (osy)\*\* that is folded upon itself to make a dual-layer flap having a basis weight of about 0.8 osy. For example, containment flaps 58 preferably comprise at least one layer of a nonwoven such as a spunbond, bonded-carded web, or spun-lace material comprised of polymers such as polypropylene, polyethylene, polyester, or nylon. The material is made wettable by the use of surfactants, such as Triton or Aerosol OT. An example of such a containment flap is produced by folding a layer of 0.4 osy Triton-treated spunbond polypropylene over an elastomeric material to produce a two-layer flat material.

Elastic members 66 can be any suitable elastic material, such as natural rubber, synthetic rubber, or thermoplastic elastomeric polymers, and can be single or multiple threads or ribbons thereof. Optionally, these materials can be heat-shrinkable or heat-elasticizable. Preferably, elastic members 66 each comprise two strands of 470 Decitex Lycra (Decitex being the weight in grams of a single thread which is 10,000 meters long), and at 90% of ultimate elongation provide a tension between about 25 grams to about 75 grams. The material permits containment flaps 58 to retract from about 30% to about 80% of their elongated length. More preferably, the material has about 50 grams force after one minute hold-time at 90% of ultimate elongation and the ability to retract to at least about 50% of the original length.

Side flaps 60 preferably comprise two layers of 0.8 osy spunbonded polypropylene, and can be liquid permeable, liquid impermeable, or liquid impermeable-vapor permeable. For example, side flaps 60 can comprise at least one layer of a nonwoven, such as a spunbonded, bonded-carded web, or spun-laced material

\* 1 denier = 1/9 tex = 1/9 g/km

\* 1 psi = 0.069 bar

\*\* 1 osy = 33.91 g/m<sup>2</sup>

comprised of polymers such as polypropylene, polyethylene, polyester, or nylon. The material is preferably non-wettable (hydrophobic) in nature. This 0.8 osy side flap comprises a layer of 0.8 osy spunbonded polypropylene which is disposed over an elastomeric material to produce a two-layer flap material.

Elastic members 70 can be made of the same material as elastic members 66. Preferably, elastic members 70 each comprise 3 strands of 620 Decitex Lycra, and at an elongation of 90% of ultimate elongation provide a tension between about 50 to about 150 grams. The material permits side flaps 60 to retract from about 30% to about 80% of their elongated length. More preferably, the material has about 50 grams force after one minute hold-time at 90% of ultimate elongation and the ability to retract to at least about 45% of the original length.

Stretchable ears 82 can be made of any suitable material having elastic or stretchable properties. Some examples of such materials are a stretch-bonded laminate comprising two gatherable layers of about 0.4 osy polypropylene spunbond having therebetween a layer of meltblown elastic material such as Kraton or polyurethane-based polymer. The layer of the elastomeric is stretched and then the two layers of polypropylene are joined thereto and upon relaxing the layers, the two polypropylene layers gather. Other stretch-bonded laminates can be produced from elastomeric film such as Kraton or urethane, elastomeric ribbons or threads such as Lycra, rubber, Pebax, urethane, or combinations thereof. The stretchable ears can also comprise alternative elastomeric materials, such as a stretchable urethane foam or polyurethane spunbond fabric similar to that manufactured by Kanebo. The stretchable ears can be made from a single elastomeric fabric or combinations of several elastomeric fabrics.

The position of hook tabs 88 on stretchable ears 82 and the position of loop panel 90 on backsheet 30 are important to the proper functioning of disposable diaper 10. Loop panel 90 should exclude about 1 1/2 inches of the center of backsheet 30 to provide two loop sub-panels 91, 93. Loop sub-panels 91, 93 should be placed about 3/4 inch from the lateral sides 54 of backsheet 30. This is designed to ensure engagement between hook tab 88 and loop panel 90 in preferred areas. For example, if hook tabs 88 are positioned too near centerline 62 of backsheet 30, that tension created by stretchable ears 82 can cause (1) the elastic material to stretch beyond its elastic limits, (2) front panel 32 to droop or fold-over, and (3) red-markings on the skin; or if hook tabs 88 engage loop panel 90 too near lateral sides 54, that tension created by stretchable ears 82 can cause red marking on the skin. The loop panel width being larger than the width of the hook tab width allows the user some adjustment for baby waist dimension differences. Proper ear tension will improve attachment between the hooks and loops, and can prevent front panel droop caused by low tensions of about 300 grams or less and red marking of the skin or other irritation

caused by high tensions above about 1200 grams. Tensions of at least about 100 grams are required to improve attachment between the hooks and loops. Proper ear tensions fall generally within the range of about 300 grams to about 1200 grams to prevent front panel droop.

Preferably, the width of ears 82 should be about 1.5 inches to about 2.5 inches, and the elastic force band should be preferably about 1.25 inches to about 2.25 inches above the front edge of the absorbent pad.

Ears 82 can be designed with higher tensions through the center and lower tensions outside these higher tension bands. Ears 82 also can be designed with uniform tension throughout the material.

Absorbent structure 14 can comprise surge portion 98 and retention portion 100. Surge portion 98 is in liquid communication with retention portion 100, and temporarily stores up to about 100% of a liquid insult, and subsequently releases liquid to retention portion 100. As illustrated, surge portion 98 is generally rectangular-shaped having a weight range of about 0.5 to about 15 grams of material and a surface area of about 10 square inches to about 50 square inches, and is positioned between the longitudinal ends of absorbent structure 14 and centered along centerline 62. Surge portion 98 overlies retention portion 100, which is of generally hour-glass shape. Other geometric forms and placements of surge portion 98 and retention portion 100 are contemplated by the present invention, such as surge portion 98 being disposed within retention portion 100 to form a single-layer structure. If desired, surge portion 98 can be joined to retention portion 100 by a bonding and/or fiber entanglement mechanism, such as ultrasonic, adhesive, or thermal bonding, or mechanical or hydraulic needling. Surge portion 98 can extend the full length of absorbent structure 14, or can be shorter in length and disposed in or near the front or back of absorbent structure 14.

Absorbent structure 14 can be manufactured in various shapes and with selected absorbent capacities compatible with the size of and the liquid loading imparted by the intended wearer.

A capillary force differential created at the interface between surge portion 98 and retention portion 100 can improve the characteristics of absorbent structure 14. If surge portion 98 has and maintains relatively lower capillary attraction compared to the capillary attraction of retention portion 100, liquid surges will tend to be desorbed more readily from surge portion 98 into retention portion 100.

Retention portion 100 can comprise various types and mixtures of fibrous material. For example, retention portion 100 may comprise cellulosic fluff, synthetic fibers, absorbent gelling materials in the form of particles, fibers, layers and the like, and various mixtures or blends thereof. Suitable absorbent gelling materials can be inorganic materials such as silica gels, or organic compounds such as cross-linked polymers. Some examples of absorbent gelling material polymers

include polyacrylamides, polyvinyl alcohol, polyacrylates, and the like. Other acceptable polymers include acrylonitrile grafted starch, acrylic acid grafted starch, modified carboxy methyl cellulose, and the like.

Retention portion 100 can also comprise a mixture of about 1% to about 30% by weight of an inherently wettable polymer, such as Hydrofil®, polyester, Pebax®, or wettable polyethylene or polypropylene; about 5% to about 90% by weight absorbent gelling material; and about 20% to about 80% by weight cellulosic fluff. More preferably, retention portion 100 can be about 2% to about 15% by weight of an inherently wettable polymer, about 15% to about 50% by weight absorbent gelling material, and about 45% to about 70% by weight cellulosic fluff. Retention portion 100 can have a basis weight in the range of about 200 to about 3000 gsm. A preferred range is between about 500 to about 1000 gsm. A more preferred basis weight is about 900 gsm. Retention portion 100 can have a density in the range of about 0.08 to about 0.40 g/cc. A preferred range is between about 0.15 to about 0.30 g/cc. A preferred density is about 0.22 g/cc. With respect to the density measurement of retention portion 100, it is calculated from its basis weight and thickness, and is measured on newly unpacked, unfolded, and desiccated diapers.

Surge portion 98 can comprise the same types of materials as retention portion 100. Preferably, surge portion 98 comprises Hydrofil® material having a basis weight between about 100 to about 600 gsm, a density between about 0.05 to about 0.15 g/cc, and a surface area between about 10 to about 50 square inches, i.e., about 64.5 to about 322 centimeters square. Preferably, surge portion 98 has a basis weight of about 400 gsm, a density of about 0.1 g/cc and a surface area of about 25 square inches.

The entire absorbent structure 14 can be wrapped in a hydrophilic web made of the same material as topsheet 26, a wood fiber tissue, or a powder-bonded polyester carded web having a basis weight between about 15 to about 30 gsm.

While this invention has been described as having preferred embodiments, it will be understood that it is capable of further modifications. This application is therefore intended to cover any variations, uses, or adaptations of the invention following the general principles thereof, and including such departures from the present disclosure as come within known or customary practice in the art to which this invention pertains and fall within the limits of the appended claims.

#### Claims

1. A disposable absorbent article (10), comprising a liquid permeable topsheet (26), having a topsheet periphery (40) with a topsheet peripheral measurement said topsheet (26) further including an opening (38) adapted for receiving body wastes therethrough, a liquid impermeable backsheet (30)

having a backsheet periphery (42) with a backsheet peripheral measurement which is greater than said topsheet peripheral measurement and an absorbent structure (14) between said topsheet and said backsheet, said topsheet periphery (40) being joined to said backsheet periphery (42) to form a waste-containment pocket (56) there between, characterised in that said liquid permeable topsheet (26) being adapted to substantially fully contact the body of the wearer and, said absorbent structure having a crotch width between 5.08 and 7.62 cm (2 and 3 inches).

2. The article of claim 1 wherein said topsheet (26) includes opposite longitudinal ends (44, 46) and opposite lateral sides (48), said ends and said sides forming said topsheet periphery (40) and said backsheet (30) includes opposite longitudinal ends (50, 52) and opposite lateral sides (54), said ends and said sides forming said backsheet periphery (42).

3. The article of claim 1 or 2, wherein said waste-containment pocket (56) has a volume of at least about 150 cubic centimeters.

4. The article of claims 2 or 3, further comprising a waist elastic member (80) near one end of said longitudinal ends, said waist elastic member (80) being peripherally joined only to said backsheet (30).

5. The article of one of the preceding claims, further comprising a breathable panel (92) near one of said longitudinal ends and having an area of at least about 40 square centimeters.

6. The article of claim 5, wherein said breathable panel (92) has a water vapor transmission rate of at least about 2000 grams per square meter per 24 hours ( $\text{g/m}^2/24 \text{ hrs.}$ ).

7. The article of claim 5 or 6, wherein said breathable panel has an effective breathable area of at least about 20 square centimeters.

8. The article of one of the preceding claims, further comprising a pair of stretchable ears at one of said longitudinal ends, said stretchable ears (82) having one of a plurality of loop members (90) and a plurality of hook members (88) thereon, the other of said longitudinal ends having the other of said plurality of loop members (90) and said plurality of hook members (88) thereon.

9. The article of one of the preceding claims, wherein one of said topsheet (26) and said backsheet (30) has a width between 12.5 to 17.5 cm (5 inches to 7 inches).

10. The article of one of the preceding claims, wherein said absorbent structure (14) has an opening therein having a volume of at least about 20 cubic centimeters, and/or said absorbent structure having an overall width of 10 to 12.5 cm (4 inches to 5 inches).

11. The article of one of claims 2 to 10, further comprising a pair of containment flaps (58) positioned at respective one of said lateral sides (48) of said liquid permeable topsheet (26) and a pair of side flaps (60) positioned at respective one of said lateral sides (48) of said liquid permeable topsheet (26).

12. The article of claim 11, wherein said containment flaps (58) and said side flaps (20) are liquid permeable.

13. The article of claim 11, wherein said containment flaps (58) and said side flaps (60) are liquid impermeable.

14. The article of claim 11, wherein said containment flaps (58) and said side flaps (60) are liquid impermeable and vapor permeable.

15. The article of claim 11, wherein said containment flaps (58) are liquid impermeable and said side flaps (60) are liquid permeable.

16. The article of claim 11, wherein selected portions of said containment flaps (58) are liquid permeable and remaining portions of said containment flaps are liquid impermeable.

17. The article of claim 11 or 16, wherein selected portions of said side flaps (60) are liquid permeable and remaining portions of said side flaps (60) are liquid impermeable.

18. The article of one of claims 11 to 17, wherein said side flaps (60) are elasticized and have a stretched-out length greater than the length of said backsheet (30) and/or wherein said topsheet (26) is made of stretchable material.

19. The article of one of the preceding claims, wherein said backsheet (30) expands for the containment of body wastes.

20. The article of one of the preceding claims, wherein said backsheet (30) is a pleated backsheet.

21. The article of one of claims 1 to 19, wherein said backsheet (30) is a microcreped backsheet.

22. The article of one of the preceding claims, wherein said backsheet (30) expands by at least about 20

percent and/or under a force of at least about 10g per cm (25 grams per inch).

23. The article of one of the preceding claims, wherein said topsheet (26) is made of stretchable material, and/or said absorbent structure (14) has an overall width of 10 to 12.5 cm (4 inches to 5 inches).

#### Patentansprüche

1. Saugfähiger Wegwerfartikel (10), der eine flüssigkeitsdurchlässige obere Schicht (26) mit einem Rand (40) der oberen Schicht mit einer Abmessung des Randes der oberen Schicht, wobei die obere Schicht (26) des weiteren eine Öffnung (38) aufweist, welche darauf ausgerichtet ist, durch die Öffnung tretende Ausscheidungen des Körpers aufzunehmen, eine flüssigkeitsundurchlässige Rückschicht (30) mit einem Rückschichtrand (42) mit einer Abmessung des Randes der Rückschicht, welche größer als die Abmessung des Randes der oberen Schicht ist, und eine saugfähige Struktur (14) zwischen der oberen Schicht und der Rückschicht umfaßt, wobei der Rand (40) der oberen Schicht mit dem Rückschichtrand (42) verbunden ist, um eine Tasche (56) zum Zurückhalten von Ausscheidungen dazwischen auszubilden, dadurch gekennzeichnet, daß die flüssigkeitsdurchlässige obere Schicht (26) darauf ausgerichtet ist, den Körper des Trägers im wesentlichen vollständig zu kontaktieren und die saugfähige Struktur eine Schrittbreite zwischen 5,08 und 7,62 cm (2 und 3 Inch) aufweist.

2. Artikel gemäß Anspruch 1, bei dem die obere Schicht (26) gegenüberliegende Längsenden (44, 46) und gegenüberliegende laterale Seiten (48) aufweist, wobei die Enden und die Seiten den Rand (40) der oberen Schicht ausbilden, und die Rückschicht (30) gegenüberliegende Längsenden (50, 52) und gegenüberliegende laterale Seiten (54) aufweist, wobei die Enden und die Seiten den Rückschichtrand (42) ausbilden.

3. Artikel gemäß Anspruch 1 oder 2, bei dem die Tasche (56) zum Zurückhalten von Ausscheidungen ein Volumen von mindestens etwa 150 Kubikzentimetern aufweist.

4. Artikel gemäß Anspruch 2 oder 3, der des weiteren ein Taillenelement (80) in der Nähe von einem Ende der Längsenden aufweist, wobei das Taillenelement (80) peripher nur mit der Rückschicht (30) verbunden ist.

5. Artikel gemäß einem der vorhergehenden Ansprüche mit weiterhin einer atmungsaktiven Bahn (92) in der Nähe von einem der Längsenden und mit

- einer Fläche von mindestens etwa 40 Quadratzentimetern.
6. Artikel gemäß Anspruch 5, bei dem die atmungsaktive Bahn (92) einen Wasserdampfdurchlässigkeitsgrad von mindestens etwa 2000 Gramm pro Quadratmeter pro 24 Stunden ( $\text{g/m}^2/24 \text{ Std.}$ ) aufweist.
  7. Artikel gemäß Anspruch 5 oder 6, bei dem die atmungsaktive Bahn eine effektive atmungsaktive Fläche von mindestens etwa 20 Quadratzentimetern aufweist.
  8. Artikel gemäß einem der vorhergehenden Ansprüche, der des weiteren ein Paar dehnbare Ohren an einem der Längsenden aufweist, wobei die dehnbaren Ohren (82) hierauf eine Mehrzahl aus einer Mehrzahl an Ösenelementen (90) und einer Mehrzahl an Hakenelementen (88) aufweisen und die anderen der Längsenden hierauf die andere Mehrzahl aus der Mehrzahl an Ösenelementen (90) und der Mehrzahl an Hakenelementen (88) aufweisen.
  9. Artikel gemäß einem der vorhergehenden Ansprüche, bei dem eine Schicht ausgewählt aus der oberen Schicht (26) und der Rückschicht (30) eine Breite zwischen 12,5 und 17,5 cm (5 Inch und 7 Inch) aufweist.
  10. Artikel gemäß einem der vorhergehenden Ansprüche, bei dem die saugfähige Struktur (14) eine Öffnung hierin mit einem Volumen von mindestens etwa 20 Kubikzentimetern aufweist und/oder die saugfähige Struktur eine Gesamtbreite von 10 bis 12,5 cm (4 Inch bis 5 Inch) aufweist.
  11. Artikel gemäß einem der Ansprüche 2 bis 10, der des weiteren ein Paar Zurückhalteklappen (58), die an der entsprechenden der lateralen Seiten (48) der flüssigkeitsdurchlässigen oberen Schicht (26) angeordnet sind, und ein Paar Seitenklappen (60), die an der entsprechenden der lateralen Seiten (48) der flüssigkeitsdurchlässigen oberen Schicht (26) angeordnet sind, aufweist.
  12. Artikel gemäß Anspruch 11, bei dem die Zurückhalteklappen (58) und die Seitenklappen (60) flüssigkeitsdurchlässig sind.
  13. Artikel gemäß Anspruch 11, bei dem die Zurückhalteklappen (58) und die Seitenklappen (60) flüssigkeitsundurchlässig sind.
  14. Artikel gemäß Anspruch 11, bei dem die Zurückhalteklappen (58) und die Seitenklappen (60) flüssigkeitsundurchlässig und dampfdurchlässig sind.
  15. Artikel gemäß Anspruch 11, bei dem die Zurückhalteklappen (58) flüssigkeitsundurchlässig und die Seitenklappen (60) flüssigkeitsdurchlässig sind.
  16. Artikel gemäß Anspruch 11, bei dem ausgewählte Bereiche der Zurückhalteklappen (58) flüssigkeitsdurchlässig und restliche Bereiche der Zurückhalteklappen flüssigkeitsundurchlässig sind.
  17. Artikel gemäß Anspruch 11 oder 16, bei dem ausgewählte Bereiche der Seitenklappen (60) flüssigkeitsdurchlässig und restliche Bereiche der Seitenklappen (60) flüssigkeitsundurchlässig sind.
  18. Artikel gemäß einem der Ansprüche 11 bis 17, bei dem die Seitenklappen (60) elastisch sind und eine Länge im ausgedehnten Zustand aufweisen, welche größer als die Länge der Rückschicht (30) ist, und/oder wobei die obere Schicht (26) aus dehnbarem Material hergestellt ist.
  19. Artikel gemäß einem der vorhergehenden Ansprüche, bei dem sich die Rückschicht (30) zum Zurückhalten von Ausscheidungen des Körpers ausdehnt.
  20. Artikel gemäß einem der vorhergehenden Ansprüche, bei dem die Rückschicht (30) eine gefaltete Rückschicht ist.
  21. Artikel gemäß einem der Ansprüche 1 bis 19, bei dem die Rückschicht (30) eine mikrogekrepte Rückschicht ist.
  22. Artikel gemäß einem der vorhergehenden Ansprüche, bei dem sich die Rückschicht (30) um mindestens etwa 20 Prozent und/oder unter einer Kraft von mindestens etwa 10 g pro cm (25 Gramm pro Inch) ausdehnt.
  23. Artikel gemäß einem der vorhergehenden Ansprüche, bei dem die obere Schicht (26) aus dehnbarem Material hergestellt ist und/oder die saugfähige Struktur (14) eine Gesamtbreite von 10 bis 12,5 cm (4 Inch bis 5 Inch) aufweist.

#### Revendications

1. Article absorbant jetable (10), comprenant une feuille supérieure (26) perméable aux liquides, ayant une périphérie de feuille supérieure (40) présentant une dimension périphérique de feuille supérieure, ladite feuille supérieure (26) comprenant en outre une ouverture (38) adaptée à recevoir, au travers d'elle, des déchets corporels, une feuille support (30) imperméable aux liquides ayant une périphérie de feuille support (42) présentant une dimension périphérique de feuille support qui est supérieure à ladite mesure périphérique de feuille supérieure, et une structure absorbante (14)

- entre ladite feuille supérieure et ladite feuille support, ladite périphérie de feuille supérieure (40) étant réunie à ladite périphérie de feuille support (42) pour former une poche de retenue de déchets (56) entre elles, caractérisé en ce que
- ladite feuille supérieure (26) perméable aux liquides est adaptée à être en contact sensiblement total avec le corps d'un porteur et
- ladite structure absorbante (14) a une largeur d'entrejambe comprise entre 5,08 et 7,62 cm (entre 2 et 3 pouces).
2. Article selon la revendication 1, dans lequel ladite feuille supérieure (26) comprend des extrémités longitudinales opposées (44, 46) et des côtés latéraux opposés (48), lesdites extrémités et lesdits côtés formant ladite périphérie de feuille supérieure (40) et dans lequel ladite feuille support (30) comprend des extrémités longitudinales opposées (50, 52) et des côtés latéraux opposés (54), lesdites extrémités et lesdits côtés formant ladite périphérie de feuille support (42).
  3. Article selon la revendication 1 ou 2, dans lequel ladite poche de retenue de déchets (56) a un volume d'au moins environ 150 cm<sup>3</sup>.
  4. Article selon les revendications 2 ou 3, comprenant en outre un élément élastique de ceinture (80) au voisinage d'une extrémité desdites extrémités longitudinales, ledit élément élastique de ceinture (80) n'étant réuni périphériquement qu'à ladite feuille support (30).
  5. Article selon l'une des revendications précédentes, comprenant en outre un panneau respirant (92) au voisinage de l'une desdites extrémités longitudinales et ayant une surface d'au moins environ 40 cm<sup>2</sup>.
  6. Article selon la revendication 5; dans lequel ledit panneau respirant (92) a un débit de transmission de vapeur d'eau d'au moins environ 2000 g/m<sup>2</sup>/24 h.
  7. Article selon la revendication 5 ou 6, dans lequel ledit panneau respirant (92) a une surface respirante utile d'au moins environ 20 cm<sup>2</sup>.
  8. Article selon l'une des revendications précédentes, comprenant en outre une paire d'oreilles extensibles au niveau de l'une au moins desdites extrémités longitudinales, lesdites oreilles extensibles (82) présentant en surface soit une pluralité d'éléments en boucle (90), soit une pluralité d'éléments en crochet (88), l'autre desdites extrémités longitudinales présentant en surface, selon le cas, soit une pluralité d'éléments en crochet (88), soit une pluralité d'éléments en boucle (90).
  9. Article selon l'une des revendications précédentes, dans lequel ladite feuille supérieure (26) ou ladite feuille support (30) a une largeur comprise entre 12,5 et 17,5 cm (entre 5 pouces et 7 pouces).
  10. Article selon l'une des revendications précédentes, dans lequel ladite structure absorbante (14) présente une ouverture ayant un volume d'au moins environ 20 cm<sup>3</sup> et/ou ladite structure absorbante (14) a une largeur totale allant de 10 à 12,5 cm (4 pouces à 5 pouces).
  11. Article selon l'une des revendications 2 à 10, comprenant en outre une paire de volets de retenue (58) disposés au niveau de chacun desdits côtés latéraux (48) de ladite feuille supérieure (26) perméable aux liquides et une paire de volets latéraux (60) disposés au niveau de chacun desdits côtés latéraux (48) de ladite feuille supérieure (26) perméable aux liquides.
  12. Article selon la revendication 11, dans lequel lesdits volets de retenue (58) et lesdits volets latéraux (60) sont perméables aux liquides.
  13. Article selon la revendication 11, dans lequel lesdits volets de retenue (58) et lesdits volets latéraux (60) sont imperméables aux liquides.
  14. Article selon la revendication 11, dans lequel lesdits volets de retenue (58) et lesdits volets latéraux (60) sont imperméables aux liquides et perméables à la vapeur.
  15. Article selon la revendication 11, dans lequel lesdits volets de retenue (58) sont imperméables aux liquides et lesdits volets latéraux (60) sont perméables aux liquides.
  16. Article selon la revendication 11, dans lequel des portions sélectionnées desdits volets de retenue (58) sont perméables aux liquides et des portions restantes desdits volets de retenue sont imperméables aux liquides.
  17. Article selon la revendication 11 ou 16, dans lequel des portions sélectionnées desdits volets latéraux (60) sont perméables aux liquides et des portions restantes desdits volets latéraux (60) sont imperméables aux liquides.
  18. Article selon l'une des revendications 11 à 17, dans lequel lesdits volets latéraux (60) sont élastiques et ont une longueur à l'état étiré supérieure à la longueur de ladite feuille support (30) et/ou dans lequel ladite feuille supérieure (26) est faite d'un matériau extensible.

19. Article selon l'une des revendications précédentes, dans lequel ladite feuille support (30) se dilate pour la rétention de déchets corporels.
20. Article selon l'une des revendications précédentes, dans lequel ladite feuille support (30) est une feuille support plissée. 5
21. Article selon l'une des revendications 1 à 19, dans lequel ladite feuille support (30) est une feuille support microcrêpée. 10
22. Article selon l'une des revendications précédentes, dans lequel ladite feuille support (30) se dilate d'au moins environ 20 % et/ou sous une force d'au moins environ 10 g/cm (25 g/pouce). 15
23. Articles selon l'une des revendications précédentes, dans lequel ladite feuille supérieure (26) est faite d'un matériau extensible, et/ou ladite structure absorbante (14) a une largeur globale allant de 10 à 12,5 cm (4 pouces à 5 pouces). 20

25

30

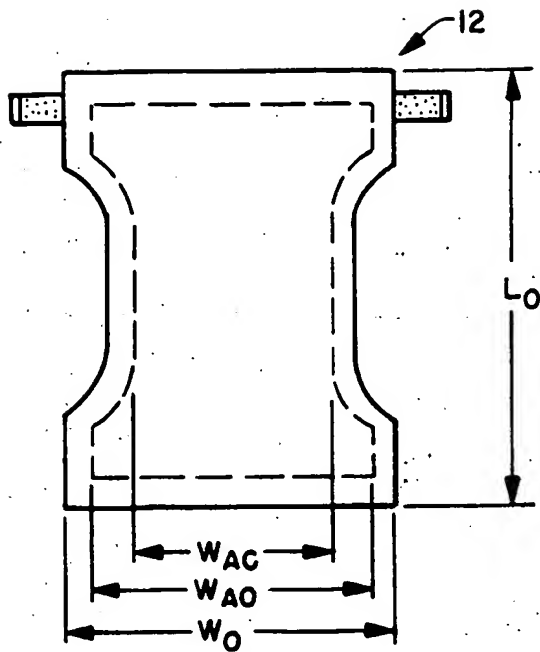
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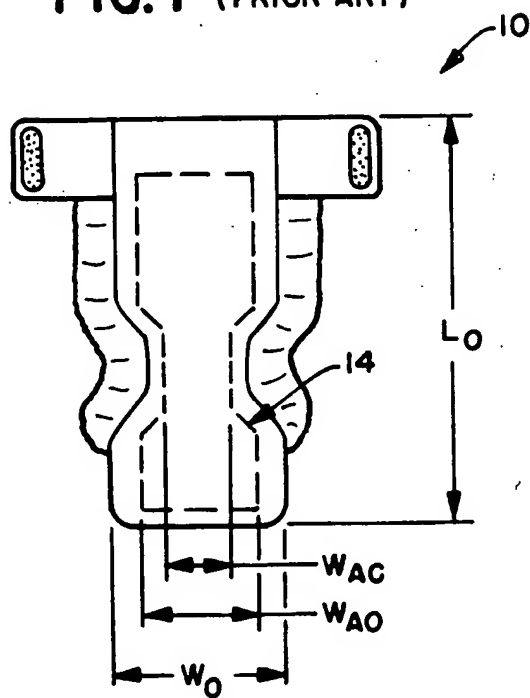
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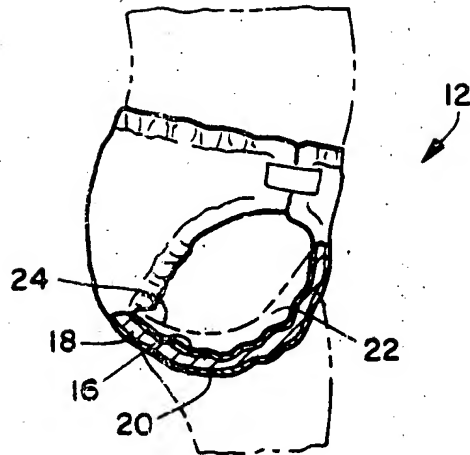
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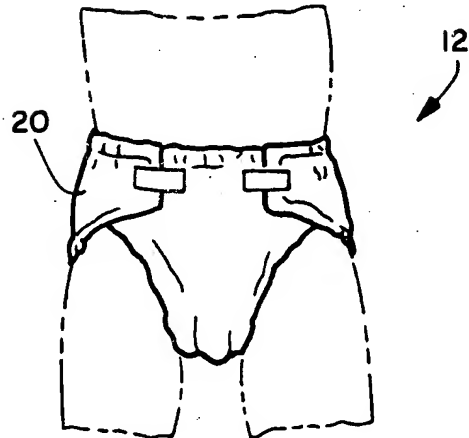
**FIG. 1** (PRIOR ART)



**FIG. 2**



**FIG. 3A (PRIOR ART)**



**FIG. 3B (PRIOR ART)**

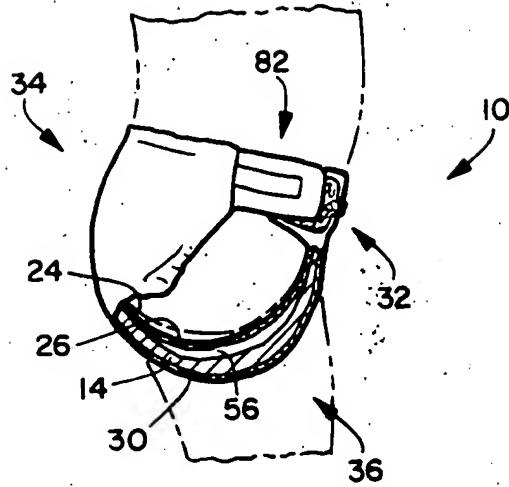


FIG. 4A

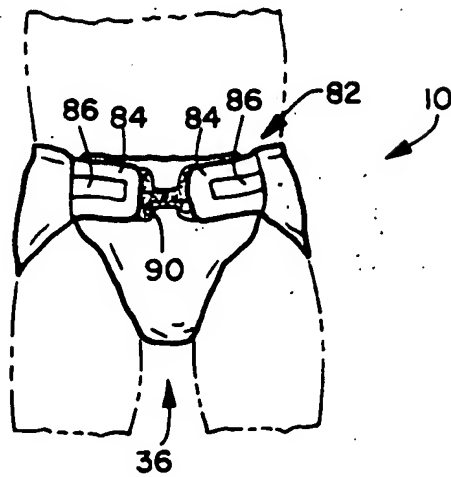


FIG. 4B

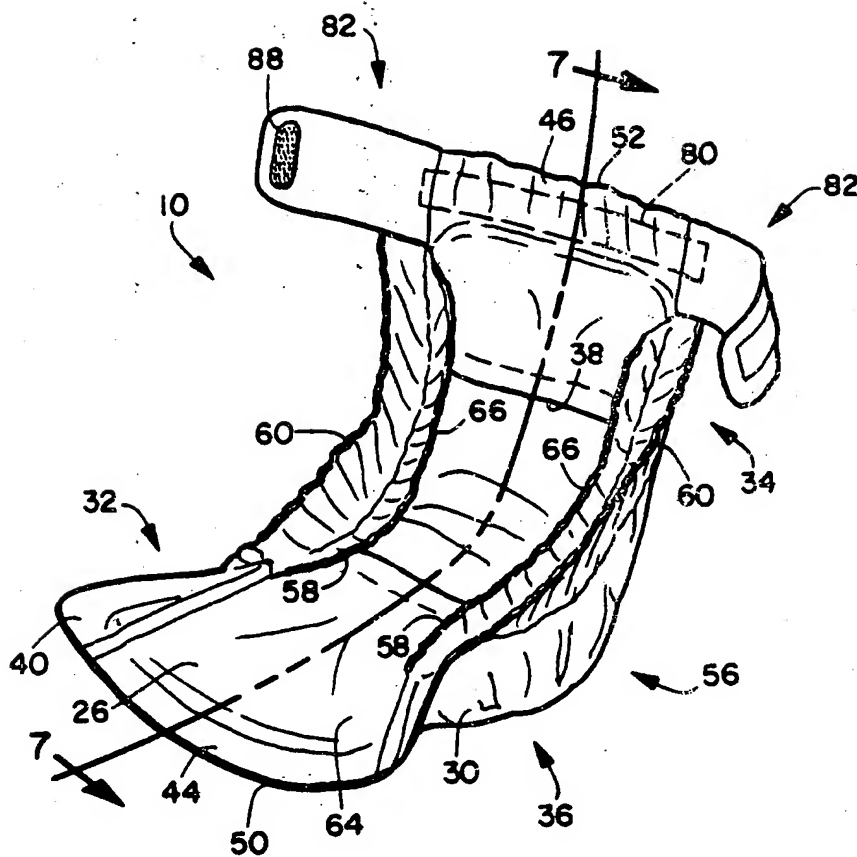


FIG. 5

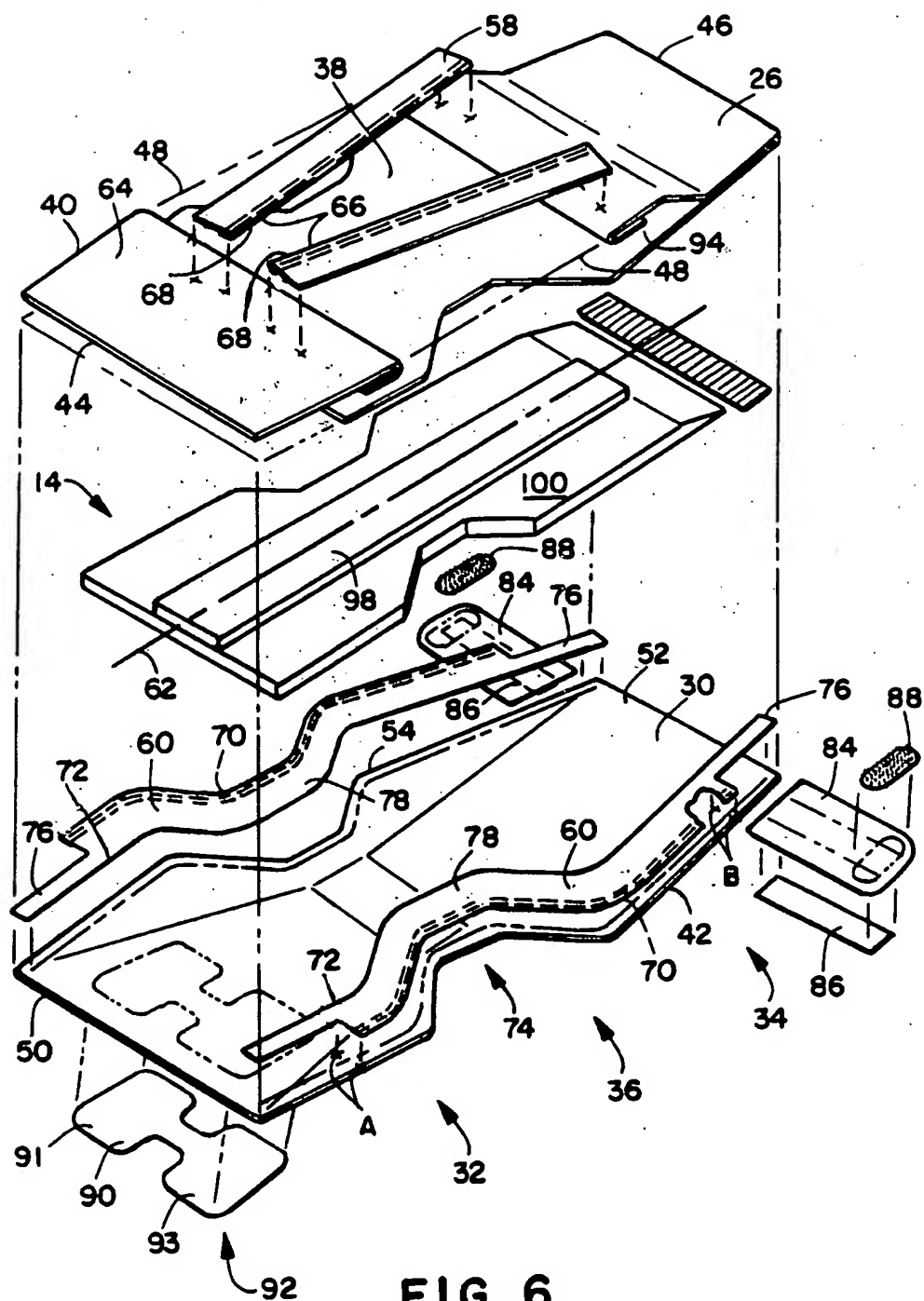


FIG. 6

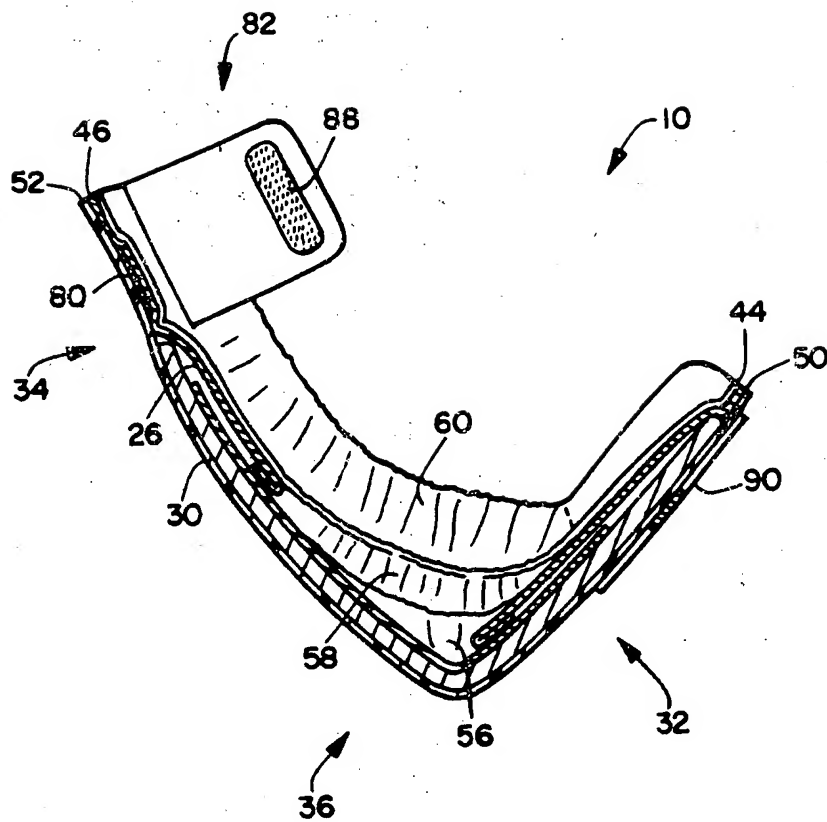


FIG. 7

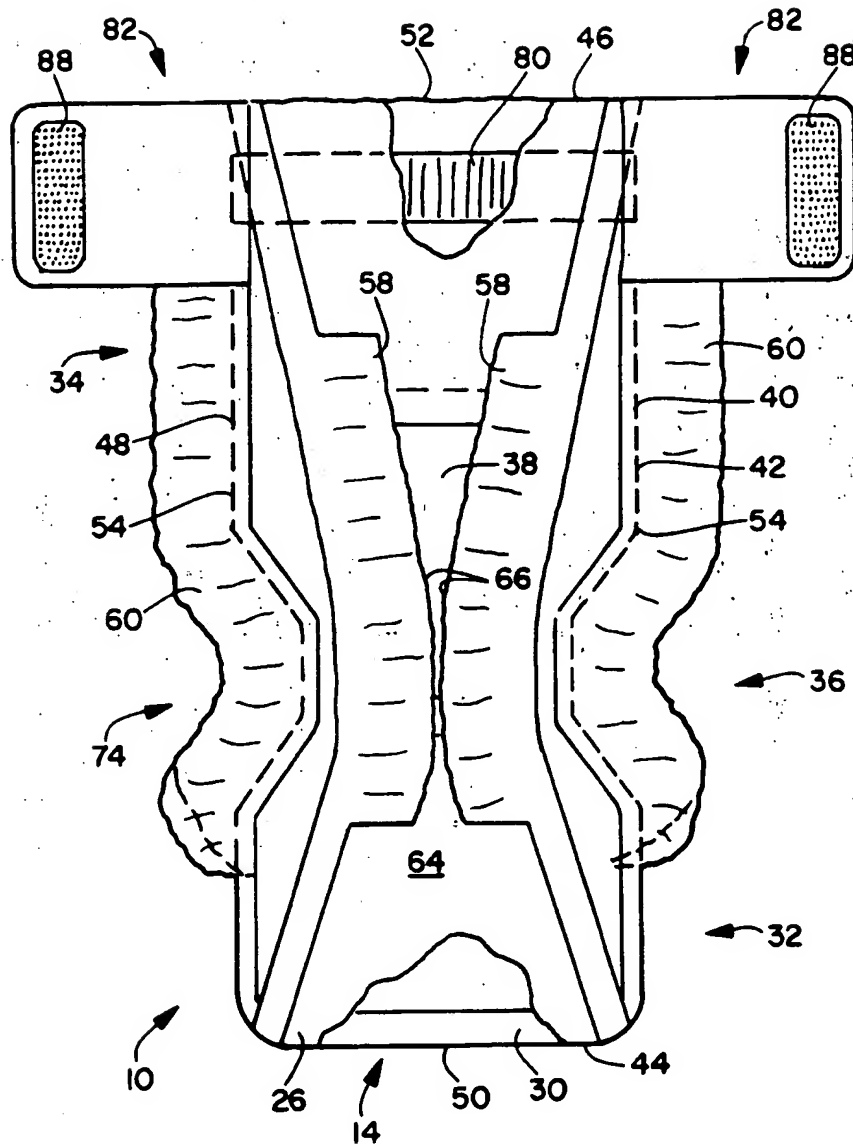


FIG. 8

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